50X1-HUM

CLASSIFICATION C-O-N-F-I-D-E-N-T-I-A-L

CENTRAL INTELLIGENCE AGENCY
INFORMATION FROM
FOREIGN DOCUMENTS OR RADIO BROADCASTS

REPORT

CD NO.

COUNTRY	China	DATE OF INFORMATION	1951
SUBJECT	Transportation - Rail, operation		
HOW PUBLISHED	Monthly periodical	DATE DIST.	17 May 1955
WHERE PUBLISHED	Peiping	NO. OF PAGES	16
DATE PUBLISHED	Apr 1951		
LANGUAGE	Chinese	SUPPLEMENT TO REPORT NO.	

THIS IS UNEVALUATED INFORMATION

SOURCE Jen-min T'ieh-tao, Vol III, No 4, 1951

METHODS OF COMPUTING SECTIONAL AND NATIONAL RAILWAY TURNAROUND TIMES IN CHINA

[Comment and Summary: This report presents information on computing railway turnaround times in China, taken from an article by Tsung Chi-lung in the Peiping monthly periodical Jen-min T'ieh-tao for April 1951.

Topics discussed include the following: (1) turnaround time for a section and for a whole unit, (2) the origin of major and minor turnaround times, (3) relation between sectional and national turnaround times, (4) fulfillment of turnaround targets, (5) effect of operational conditions on sectional and national turnaround relationship, and (6) factors of space, time, and operational conditions in car turnaround.

For convenience, abbreviations for various terms used in the original article have been devised and used in formulas and equations.]

A. Meaning of Turnaround Time for a Section and a Whole Unit

Turnaround time [TRT], or turnaround rate, is commonly reckoned for a number of areas of unlike scope, but they all have a bearing on each other. The turnaround time for a major territory of large scope includes or is determined by the turnaround time of a number of minor, or subsidiary, areas. The turnaround time (major) of the country is composed of the turnaround times (minor) of the main networks of the whole railway system, namely, the Northeast and North-South China networks. It is also proper to speak of the turnaround time (major) of a railway control bureau as a whole, which would in turn, be comprised of the turnaround times (minor) of its subsidiary bureaus and subbureaus. And the turnaround time (major) of a subbureau is

CLASSIFICATION C-O-N-F-I-D-E-N-T-I-A-L

STATE		NAVY		NSRB		DISTRIBUTION					
ARMY		AIR		FBI							

 [redacted] 50X1-HUM

composed of the turnaround time (minor) of train dispatchers' offices and suboffices. Figures for turnaround time are not absolute but contingent; they vary according as the actual performance of transport operations varies.

B. Origin of Turnaround Times (Major and Minor)

As is well known, turnaround time is calculated by two different methods: (1) the time-count method, depending on technical operational data, and (2) the car-count method, depending on the number of cars in operation [COP] and the daily work load [DWL].

The formula for turnaround time using the time-count method is a follows:

$$TRT = \frac{1}{24}\left[\frac{(1 + ECK\%) \times TRD}{TRVS} + \frac{(1 + ECK\%) \times TRD}{SWD} \times STOVT + \frac{(NCL + CUN)}{DWL} \times LAOVT\right]$$

The following factors are involved in using the time-count method:

Empty car percentage [ECK%], which equals empty car-kilometrage [ECK] divided by loaded car-kilometrage [LCK]

Turnaround distance [TRD]

Travel speed [TRVS]

Average switching distance [SWD]

Stopover time in the switching or stopover stations [STOVT]

Number of cars loaded, daily [NCL]

Number of loaded cars [NLC] and number of loaded cars received from other territory [NLCR]

Number of cars unloaded (daily) [CUN]

Daily work load [DWL], which equals number of cars loaded in the home territory plus the number of loaded cars that are received from outside the home territory in one 24-hour day [DWL = NCL + NLCR]

Layover time [LAOVT], in station of loading or unloading. [Comment: for further explanation of these terms, [redacted] 50X1-HUM

The formula for turnaround time using the car-count method is:

$$TRT = \frac{COP}{DWL}$$

If the basic data are correct, these two formulas should yield [nearly, if not exactly] the same results.

50X1-HUM

If we know the number of cars in operation in a given territory or unit and the daily work load for the same territory or unit, use of the second formula is much simpler. Therefore, we use the car-count formula when we want to calculate the actual turnaround time of freight cars, or if the turnaround time of each of the different types of cars has been computed and we want to calculate the turnaround time for all the cars, or if we want to find out the turnaround time (major) for a certain territory.

When calculating the actual turnaround time, the number of cars in operation and the figures for the number of cars loaded and the number of loaded cars received from another territory are readily ascertainable from available reports.

If we want to calculate the turnaround time for all cars, the number of cars in operation of each type should first be computed from the figures for daily work load and turnaround time for each type. The numbers of cars in operation of each type added together will give the figure for the whole number of cars in operation. The daily work load for each type of car added together will give the figure for the whole daily work load.

To get the turnaround time (major) for a certain territory or office, the total number of cars in operation will be the sum of the numbers of cars in operation in each of the subsidiary offices, and the daily work load (major) is equal to the sum of the numbers of cars loaded in each subsidiary area plus the number of loaded cars received from outside the major territory in point.

To illustrate: To calculate by the car-count formula the turnaround time (major) for all the standard-guage cars in the North-South China network, assume that the number of cars in operation and the daily work load for the respective subsidiary areas are as indicated in the following equation.

50X1-HUM

$$\text{TRT (major)} = \frac{\text{COP}}{\text{DWL}} = \frac{\text{Tientsin Bureau 5,000 COP} + \text{Tsinan Bureau 4,500 COP}}{\text{Tientsin Bureau 2,000 NCL} + \text{Tsinan Bureau 1,800 NCL}}$$

$$\frac{+ \text{ Cheng-chou Bureau 4,000 COP} + \text{T'ai-yuan Bureau 3,000 COP}}{+ \text{ Cheng-chou Bureau 1,500 NCL} + \text{T'ai-yuan Bureau 1,200 NCL}}$$

$$\frac{+ \text{ Shanghai Bureau 3,500 COP} + \text{Heng-yang Bureau 3,200 COP}}{+ \text{ Shanghai Bureau 1,600 NCL} + \text{Heng-yang Bureau 1,000 NCL}}$$

$$\overline{+ \text{ 500 (NLCR) received [through Shan-hai-kuan station (?)]}}$$

$$= \frac{22,200}{9,600} = 2.31 \text{ days}$$

(Figures for T'ai-yuan Bureau concern standard-gauge cars only.)

In the same way, we can take the combined number of cars in operation in the North-South China and Northeast networks, and the number of cars loaded in both networks plus the number of loaded cars received from outside the national boundaries [through Man-chou-li (Lu-pin)?], and calculate the turnaround time (major) for all the standard-gauge freight cars of the country as a whole. In like manner, the figures for any subsidiary areas may be combined to find the turnaround time for the major area to which they belong.

When the turnaround time for a minor area is to be calculated, e.g., when the ministry wants to find the turnaround time for each of its railway control bureaus, or when a railway control bureau wants to find the turnaround time for each of its bureaus or subbureaus, only data on the technical operations in each subordinate unit are available, while the figures for the total number of cars in operation are not known. In such cases, it is better to use the time-count formula. When the turnaround time is found for all minor areas by the time-count formula, then the number of cars in operation for any or all minor areas may be ascertained by using the second formula

$$\text{TRT} = \frac{\text{COP}}{\text{DWL}}$$

which, rearranged is

$$\text{COP} = \text{TRT} \times \text{DWL}$$

in which cars in operation is the only unknown quantity.

When a railway bureau, using the time-count formula, has calculated the turnaround time (major) for its own bureau as a whole, and the turnaround time (minor) for its subbureaus, and has used the car-count formula to find the number of cars in operation in each subbureau, then the latter figures should be added together to see if the total agrees with the figure for the number of cars in operation in the whole bureau. If they do not agree, then it is necessary to consider all the circumstances, try to account for the discrepancy, and take steps to remedy the faults, such as modifying the figure for turnaround time so that the numbers of cars in operation in major and minor areas are consistent.

With respect to the calculation of the turnaround time of the North-South China network and for the whole country, the car-count formula has always been used, and not the time-count formula. However, to check the accuracy of the technical operational data, a second calculation, using the time-count formula, is sometimes made. If the time-count calculation does not agree with the car-count calculation, there are errors in the calculations, and the calculations should be rechecked. A slight difference in the third decimal place, e.g., 3.121 and 3.122 days, due to dropping or adding small fractions in computing constituent items, is so small that it may be ignored.

C. Relation of Turnaround Time for Sections (Minor Areas) to That for Entire Country (Major Area)

The turnaround time for the entire country is not the simple arithmetical average time found by adding the turnaround time figures for the two main networks and dividing the sum by 2, e.g., $(3.0 + 3.5) \div 2 = 3.25$ days, where 3.0 days is the figure assumed for the North-South China network turnaround time, and 3.5 days the figure assumed for the Northeast turnaround time.

Assuming that the average daily work load for the North-South China network is 4,000 cars, then the number of cars in operation for this network would be:

$$COP = DWL \times TRT = 4{,}000 \times 3.0 = 12{,}000 \text{ cars.}$$

Assuming that the average daily work load for the Northeast is 5,000 cars, the number of cars in operation in the Northeast would be:

$$COP = DWL \times TRT = 5{,}000 \times 3.5 = 17{,}500 \text{ cars.}$$

Combining the figures for the two, the number of cars in operation would be:

$$COP = 12{,}000 + 17{,}500 = 29{,}500 \text{ cars.}$$

The true weighted average for the turnaround time for the whole country would then be:

$$TRT\ (\text{major}) = \frac{COP}{DWL} = \frac{12{,}000 + 17{,}500}{4{,}000 + 5{,}000} = \frac{29{,}500}{9{,}000} = 3.28 \text{ days.}$$

The reason that the weighted average turnaround time (3.28) is larger than the simple arithmetical average (3.25) is that the network with the larger turnaround time (3.5) has a larger proportion of the total daily work load of the entire country than the network with the smaller turnaround time (3.0 days).

If there were no exchange of loaded cars between the two main networks, the example above would yield a true answer, because the average number of cars loaded each day in each network would be the average daily work load for each, and their sum would be the number of cars loaded, i.e., the daily work load for the entire country.

However, the facts are otherwise; it is not true that intramural China has no transport intercourse with extramural China. There is a reciprocal exchange of loaded cars, and, taking these into account, the relationship of turnaround times for the minor areas and for the entire country is not so simple. Using the same figures as above, suppose that 500 loaded cars received from the Northeast are included in the 4,000 loaded cars handled in the North-South China network, and that the Northeast received 200 loaded cars from the other network. Then the true weighted average turnaround time for the whole country would be:

50X1-HUM

$$\text{TRT (major)} = \frac{\text{COP}}{\text{DWL}} = \frac{12{,}000 + 17{,}500}{(4{,}000 - 500) + (5{,}000 - 200)} = \frac{29{,}500}{3{,}500 + 4{,}800} = \frac{29{,}500}{8{,}300} = 3.55 \text{ days.}$$

The reason this last figure is greater than the 3.28 days computed above is that the 500 loaded cars received by the North-South network from the Northeast are included in the number of cars loaded in the Northeast; and similarly, the 200 loaded cars received in the Northeast from the North-South network are included in the 4,000 cars loaded in the North-South network. When the turnaround time (major) is being calculated, these 700 cars received by one network from another must not be counted twice, because the turnaround distance of these cars is one journey although the stations of origin and destination may be in different networks. Furthermore, with reference to the country as a whole, there have been no loaded cars "received" from outside the major territory. Hence with the denominator being smaller, (because diminished by 700), the quotient naturally will be larger.

Again, assume in connection with the above example that the average turnaround distance for the North-South network is 500 kilometers, and that for the Northeast is 800 kilometers; then the daily average total car-kilometrage [TCK] for the North-South network is 4,000 x 500 = 2 million car-kilometers; and for the Northeast it is 5,000 x 800 = 4 million car-kilometers; and for the whole country, it is their sum, 6 million car-kilometers. These figures indicate that the average freight-car turnaround distance for the country would be:

$$\text{TRD (major)} = \frac{\text{TCK}}{\text{DWL}} = \frac{6{,}000{,}000}{(4{,}000 - 500) + (5{,}000 - 200)} = 722.89 \text{ (or 723) kilometers.}$$

With reference to these figures, it will be noted that the relative increase for turnaround time for the whole country, compared with that for the two subsidiary networks, is as follows:

For the North-South network, $\frac{\text{TRT (major)}}{\text{TRT (minor)}} = (\frac{3.55}{3.00} - 1) \times 100 = 18\%$.

For the Northeast network, $\frac{\text{TRT (major)}}{\text{TRT (minor)}} = (\frac{3.55}{3.50} - 1) \times 100 = 1\%$.

The relative difference in turnaround distance for the whole country, compared with that for the two subsidiary networks, is as follows:

For the North-South network, $\frac{\text{TRD (major)}}{\text{TRD (minor)}} = (\frac{723}{500} - 1) \times 100 = 45\%$.

For the Northeast network, $\frac{\text{TRD (major)}}{\text{TRD (minor)}} = (1 - \frac{723}{800}) \times 100 = 10\%$.

Comparing the figures for the whole country with those for the North-South network, the turnaround distance increased 45 percent, while the turnaround time increased 18 percent; these increases are not in direct proportion with each other. The reason for this is the fact that in using the time-count formula for computing the turnaround time, only two of the three component factors, travel-time [TRVT] and stopover time, are affected. The third factor, layover

[redacted]

50X1-HUM

time, is not affected when the turnaround distance is lengthened or shortened. Hence, generally speaking, it is correct to say that when the turnaround is lengthened or shortened, the turnaround time is thereby affected to the extent of only two thirds of the proportional increase, thus: 45 percent x 2/3 = 30 percent. Restated, this means that 30 percent of the increase in turnaround time was due to increase in turnaround distance. (This two-thirds figure is only approximate; the precise figure would have to be determined by the actual operational data.)

The turnaround time for the whole country was only 18 percent greater than that for the North-South network. The reason for this is that the technical performance in the Northeast is superior to that in the North-South network. The turnaround time of 3.5 days for the Northeast, with a turnaround distance of 800 kilometers, is clearly a much better performance than a turnaround time of 3.0 days for the North-South network, with a turnaround distance of 500 kilometers. The national turnaround time figure has as one of its constituent factors this comparatively high technical performance of the Northeast, and that fact tends to lessen its proportional increase over the North-South network's turnaround time.

Again, comparing the whole country with the Northeast, the total turnaround distance of the former is 10 percent less than that of the latter, while the former's turnaround time is one percent greater than that of the latter. The principal reason for this is that, apart from the fact that the increase in turnaround distance influences turnaround time to the extent of only two thirds of its proportional increase, in the figure for turnaround time for the whole country, there is the factor of the relatively poor technical performance of the North-South network, and hence there is a small increase.

The increase or decrease of the turnaround time is attributable to the increase or decrease of turnaround distance and to the changes in the various aspects of operational performance. Turnaround time, turnaround distance, and operational performance are very closely interrelated. This accounts for the variation in figures between those for a major unit and those for its minor constituent units.

The turnaround time of a major unit is generally greater than that of its minor units. But if the turnaround time of one or more minor units is exceptionally short, and that of another minor unit is exceptionally long, the figure for the major unit may be smaller than that of the minor unit whose figure was exceptionally long.

D. Fulfillment of Turnaround Targets

Suppose that, for a certain month, the turnaround times for the two main regions of the country were both more favorable than their respective targets. In that case, it is possible that the turnaround time (major) for the whole country will be more favorable than the planned target (major). But experience shows that the actual turnaround time (major) may be lower, the same, or higher than the target figure.

To illustrate, let us assume relatively small planned figures, using round numbers for ease of understanding and computation, for both main networks of the country, as follows:

Planned number of cars loaded: 200 for both networks.

Planned number of cars in operation: 600 for both networks.

Planned full turnaround distance: 400 kilometers for both networks.

Planned: neither network to receive any loaded cars from the other; hence, under these circumstances, number of cars loaded equals daily work load.

[redacted]

Planned: all other pertinent technical data for the cars of both networks to be the same.

Now assume that in operation the actual figures differ somewhat from the planned figures; specifically, that among the 200 cars loaded in the North-South network there are 20 loaded cars to be delivered to a point in the Northeast. The average total turnaround distance still remains 400 kilometers, but for these 20 cars, assume that half the distance is in each network. Assume also that there are no other deviations from the planned operations. In this simple illustration, the difference in operational conditions between the actual figures and the planned figures prove to be quite marked; as will be examined below.

1. How the North-South Network Is Affected

According to the car-count formula,

$$\text{(Planned) TRT (minor)} = \frac{\text{COP}}{\text{NCL}} = \frac{600}{200} = 3.0 \text{ days.}$$

$$\text{(Actual) TRT (minor)} = \frac{\text{COP}}{\text{NCL}} = \frac{600 - 1/2\ (20 \times 3)}{200} = 2.85 \text{ days.}$$

The reason for the lower actual figure is that the daily work load, in the denominator, did not change (since all of the 200 cars were loaded in this network), while the number of cars in operation was reduced by a net of 30 car-days, because the 20 cars were sent into the other network. Consequently, the actual turnaround distance was reduced, as far as this network is concerned, to the figure shown by the following equation:

$$\text{(Actual) TRD} = \frac{\text{TCK}}{\text{DWL}} = \frac{(200 - 20) \times 400 + (20 \times 200)}{200} = 380 \text{ km.}$$

The reduced turnaround distance will have an effect on the total stopover time for switching and the total travel time. Furthermore, the work rate [WR] will not be the same.

$$\text{(Planned) WR} = \frac{200 + 200}{200} = 2.0$$

$$\text{(Actual) WR} = \frac{(200 - 20) \times 2 + (20 \times 1)}{200} = 1.9$$

With reference to the above two equations: According to the planned operations, the 200 cars were each to undergo two operations in this network, loading and unloading; but actually, only 180 underwent both operations, while 20 cars underwent in this network only the loading operation. The reduction of the work rate will affect the total layover time in the terminal stations where loading and unloading take place.

2. How the Northeast Is Affected

For the Northeast, the turnaround times are as follows:

$$\text{(Planned) TRT} = \frac{COP}{NCL} = \frac{600}{200} = 3.0 \text{ days.}$$

$$\text{(Actual) TRT} = \frac{COP}{NCL + NLCR} = \frac{600 + 1/2\ (20 \times 3)}{200 + 20} = \frac{630}{220} = 2.86 \text{ days.}$$

The actual turnaround time was lowered because, on the one hand, the daily work load was increased by the 20 loaded cars received from the other network; and, on the other hand, the number of cars in operation in this network has been increased by the equivalent of 30 cars (car-days). The former factor has a reducing effect; the latter factor has an increasing effect; but the reducing factor is relatively greater in its influence than the increasing factor.

The effect on the turnaround distance is indicated below.

$$\text{(Actual) TRD} = \frac{TCK}{DWL} = \frac{(200 \times 400) + (20 \times 200)}{200 + 20} = 382 \text{ km.}$$

Because of the increase of 20 cars, whose turnaround distance in this network is only 200 kilometers, the combined average turnaround distance will be smaller. As already pointed out, if the turnaround distance is reduced, the stopover time for switching and the total travel time will both be less.

The work rate will be thus affected:

$$\text{(Planned) WR} = \frac{NCL + CUN}{DWL} = \frac{200 + 200}{200} = 2.0.$$

$$\text{(Actual) WR} = \frac{NCL + CUN}{DWL} = \frac{200 \times 2 + 20 \times 1}{200 + 20} = \frac{420}{220} = 1.91.$$

As already pointed out, if the work rate is reduced, the layover time at terminal stations is affected.

3. How the Country as a Whole Is Affected

$$\text{(Planned) TRT} = \frac{COP}{DWL} = \frac{600 + 600}{200 + 200} = \frac{1,200}{400} = 3.0 \text{ days.}$$

$$\text{(Actual) TRT} = \frac{COP}{DWL} = \frac{570 + 630}{200 + (220 - 20)} = \frac{1,200}{400} = 3.0 \text{ days.}$$

The departure from the planned movement of cars in the case of the 20 cars sent from the North-South network to the Northeast caused a change in the number of loaded cars received as regards the Northeast, since according to the original plans there were to be no cars received from another territory; but as regards the country as a whole, although there was an internal geographical

 [redacted]

change of destination in the case of the 20 cars, there was in the final reckoning no change in any of the following factors: total number of cars in operation, number of cars loaded, (and if there are no loaded cars received from the outside, then the number of cars loaded is the same as the daily work load), the total turnaround distance, and the work rate. Hence the actual turnaround time was the same as the planned turnaround time.

Resuming the general discussion: Under the circumstances predicated above, in the North-South network the actual turnaround time (minor) was 5.26 percent lower than the planned time.

$$\frac{3.0}{2.85} + 100 = 105.26$$

In the Northeast, the improvement was 4.9 percent.

$$\frac{3.0}{2.86} \times 100 = 104.9$$

But for the country as a whole, the actual turnaround time (major) compared with the planned turnaround time (major), showed that they were equal.

$$\frac{3.0}{3.0} \times 100 = 100.0; \text{ i.e., there was no change.}$$

The actual turnaround time (minor) in both networks was less than the planned figure, i.e., the target was exceeded; but in the case of the whole country, the actual turnaround time (major) was the same as the planned figure, i.e., the target was exactly fulfilled. However, there is no necessary fixed relationship between these figures, in the sense that the results will always be such. In the illustration above, the case was very simple; in practice, there are many variable factors such as empty car percentages, loaded car turnaround distances, travel speeds, average switching distances [redacted] average stopover times, and average layover times. Any or all of these factors may vary. But although there are many variable factors, there is only one uniform principle. For this reason, if both networks exceed their respective turnaround time targets (minor), the whole country's turnaround time target (major) may be exceeded, but could also fall short of fulfillment.

To put it in other words: suppose that, according to transportation plans, each network will receive a large number of loaded cars from other areas, but actually there is a drop in the number of such cars. In this case, both networks may fall short of the planned target for turnaround time, while the actual turnaround time (major) for the whole country may exactly fulfill or exceed the planned target. Depending on the variations of the actual from the planned figures, as regards the number of loaded cars "received" from each region, the actual turnaround time figure for the North-South network may exceed the target, and the Northeast fail to fulfill its target, while the whole country's actual turnaround time (major) figure may equal, surpass, or fall short of the target.

The same possibilities exist with respect to the North-South network as a major unit and its railway bureaus; to a railway bureau as a major unit and its subbureaus, and even down to a subbureau as a major unit and its train-dispatching units.

To sum up: When the number of cars actually received from another territory varies from a small planned number to a large actual number, this has a favorable effect on the turnaround time of the minor units; and when the variation is from a large planned number to a small actual number, this has an unfavorable effect on the turnaround time of the minor units.

E. Effect of Operational Conditions on Relationship of Sectional and National Turnaround Times

1. It is well-known that in calculating turnaround time [by the time-count formula] it is necessary to deal with the number of cars loaded, number of cars unloaded, daily work load, turnaround distance of loaded cars, empty car percentage, turnaround distance for all cars (loaded and empty), travel speed, average switching distance, average switching time or stopover time, work rates, and average layover time. [These are what are meant by "operational conditions."]

When calculating the [planned] turnaround time of a minor unit, in a case such as when the ministry wishes to calculate the turnaround time for each of its bureaus, or a bureau for each of its subbureaus, it is necessary to base the calculations in part on past actualities, carefully combined with intelligent judgments as to prospective changes. The planned turnaround time must not be set at a figure which will be wasteful of cars, or be one railway workers will think so easily attainable that they relax in their duties. Nor must it be so hard to attain that the workers become dispirited. Following is a simple explanation of the constitution or derivation of the various operational conditions affecting turnaround time.

a. Number of Cars Loaded, and Cars Unloaded

These figures are based on the average number of cars for which shippers have made advance requisitions, plus the number which the railway estimates will be needed to cover LCL shipments and other transportation not requested in advance.

b. Work Load

The [daily] work load is the number of cars per day which are to be loaded in the home territory, plus the number of loaded cars expected to be received from a neighboring territory. The latter figures are based on the exchange of data between the offices of adjacent territories.

c. Turnaround Distance of Loaded Cars

The turnaround distance of loaded cars is equal to the daily average total kilometrage of loaded cars divided by the daily work load. The daily average total kilometrage for loaded cars is based on the known distances of shipments arranged for in advance, plus the estimated distances probably to be covered by shipments not arranged for in advance.

d. Empty Car Percentage

The empty car percentage is equal to the daily average kilometrage of empty cars divided by the daily average kilometrage of loaded cars. This is also equivalent to the ratio between the turnaround distance of empty cars and that of loaded cars. The daily average kilometrage of empty cars is based on that of empty cars of different types, such as hopper coal cars or tank cars, which have to be returned or sent to certain places to supply cars for transportation arranged for in advance or required for estimated traffic not arranged for in advance. The empty-car turnaround distance is equivalent to the daily average empty-car total kilometrage divided by the daily work load. For convenience in calculation, a figure for the empty-car kilometrage may be guided by pertinent data previously recorded, with modifications deemed appropriate in view of changing traffic conditions; but of course, this method is not sufficiently exact.

e. Turnaround Distance for All Cars [ACTRD]

This is equal to the sum of the turnaround distances of loaded cars and empty cars. [Or: ACTRD = (1 + ECK%) x (loaded car TRD)].

f. Travel Speed

Travel speed is equal to the aggregate distance traveled by the freight trains between marshaling stations, divided by the aggregate time occupied by this travel. (The time occupied will include the time of any stops made at intermediate stations between marshaling stations.) To derive the aggregate distance and aggregate time, the distances and times of each individual train must be added together. Of course, using the data of previous performances can save work, but this is not sufficiently exact.

g. Average Switching Distance

Average switching distance is equivalent to the average daily kilometrage of loaded cars plus that of empty cars, divided by the daily average total number of [loaded and empty] cars that pass a switching [or marshaling] station, when cars are actually rearranged in the trains. [redacted] The daily average number of cars that pass a switching station [and are switched] depends on traffic conditions, and the number of loaded and empty cars in each train of cars must be added together.

h. Average Switching Time [Stopover Time]

The average stopover time is equal to the daily average total time spent by cars in a marshaling station, divided by the daily average number of cars that are handled in that marshaling station. For a particular marshaling station, the number of cars handled multiplied by the standard stopover time for that station will give the average total stopover time. If the figures for all the marshaling stations in a given area are added together, the sum will be the daily average total stopover time for all the cars switched in that area. This method of calculation is rather laborious; hence, to save work when preparing transportation plans, the figure taken for average stopover time is based on the actual figures for some previous period. But if the standard figures adopted for operations in different stations are not the same, and if the flow of traffic constantly changes, then it is not sufficiently exact to rely solely on the actual figures for previous periods.

i. Work Rate

The work rate is the sum of the number of cars loaded and the number of cars unloaded [in one 24-hour day] divided by the daily work load.

$$WR = \frac{NCL + CUN}{DWL}$$

j. Average Layover Time

The average layover time in a terminal station for loading or unloading is equal to the daily average total time spent by all the cars in a layover station, divided by the number of cars loaded plus the number unloaded.

Sanitized Copy Approved for Release 2011/07/14 : CIA-RDP80-00809A000700230144-5

50X1-HUM

$$LAOVT = \frac{\text{daily average total layover time}}{NCL + CUN}$$

The daily average number of cars loaded, plus those unloaded, multiplied by the standard layover time adopted for that station, is the daily average total layover time for that station. Frequently, to save work, deductions as to the total layover time have been made from figures in earlier operational records; but this makeshift is not sufficiently exact.

2. When gathering or ascertaining the operational data of minor units in order to compute the turnaround time of a major unit, with the exception of travel speed, it is not necessary to go back to the original records of the subsidiary units, but only to ascertain the figures for pertinent data that have already been computed. These items and methods of computation are as follows:

a. Number of Cars Loaded and Number of Cars Unloaded

NCL (major) = the sum of NCL (minor) for each minor unit. (A)

CUN (major) = the sum of CUN (minor) for each minor unit. (B)

b. Daily Work Load

$$\text{DWL (major)} = \text{NCL (major) (A)} + \text{NLCR (major) (R)} \qquad \text{(C)}$$

In equation (C), the term NLCR, represented by (R), means the number of loaded cars received from another territory.

c. Loaded Cars Turnaround Distance [(LC) TRD]

Loaded cars turnaround distance (minor) multiplied by the daily work load (minor) is equal to the daily average total loaded cars kilometrage (minor).

$$\text{(LC) TRD (minor)} \times \text{DWL (minor)} = \text{LCK (minor)} \qquad \text{(D)}$$

Loaded cars turnaround distance (major) is equal to the summation of the daily total average loaded car kilometrage (D) (minor) for each minor unit, divided by the daily work load (major).

$$\text{(LC) TRD (major)} = \frac{\Sigma\ \text{(LC) TRD (minor)}}{\text{DWL (major)}} = \frac{\text{(D)}}{\text{(C)}} \qquad \text{(E)}$$

d. Total Turnaround Distance of All Cars

The turnaround distance for all cars [loaded and empty] (minor) multiplied by the daily work load (minor) is equal to the daily average total car kilometrage for all cars (minor). (F)

The turnaround distance for all cars (major) is equal to the summation of the daily average kilometrage of all cars (minor) divided by the daily work load (major).

$$\text{(AC) TRD (major)} = \frac{\Sigma\text{(F) (minor)}}{\text{(C) (major)}} \qquad \text{(G)}$$

Sanitized Copy Approved for Release 2011/07/14 : CIA-RDP80-00809A000700230144-5

[redacted]

e. Empty Car Percentage

The empty car percentage for a major area is equal to the turnaround distance of all cars (major) minus the loaded cars turnaround distance (major) divided by the loaded cars turnaround distance (major).

$$\text{ECK\%}\ (\text{major}) = \frac{(G) - (E)}{(E)} \qquad (H)$$

f. Travel Speed

The travel speed (major) is equal to the summation of the total train kilometrage [TTK] of all the freight trains of each minor area divided by the summation of the total travel time of all the freight trains in each minor area.

$$\text{TRVS}\ (\text{major}) = \frac{\sum \text{TTK}\ (\text{minor})}{\sum \text{TRVT}\ (\text{minor})} \qquad (I)$$

g. Average Switching Distance

The total turnaround distance for all cars in a minor area, divided by the average switching distance for the minor area, equals the number of switchings, or number of stopovers, that each car, on the average, must undergo in the course of its journey.

$$\frac{(\text{AC})\ \text{TRD}\ (\text{minor})}{\text{SWD}\ (\text{minor})} = \text{average number of stopovers per car (minor)} \qquad (J)$$

[For definition and method of computing average switching distance, [redacted]

The number of stopovers per car, multiplied by the daily work load (minor) equals the total number of stopovers (minor) for all cars in operation.

$$(J) \times \text{DWL}\ (\text{minor}) = (K) \qquad (K)$$

The average switching distance of a major area is equal to the summation for all of its minor areas of the total daily average kilometrage for all cars in operation, divided by the summation, for all minor units, of the total number of stopovers for all cars in operation.

$$\text{SWD}\ (\text{major}) = \frac{\sum (F)\ (\text{minor})}{\sum (K)\ (\text{minor})} \qquad (L)$$

h. Average Stopover Time

The average number of stopovers per car (minor), multiplied by average stopover time per car (minor), equals the total stopover time per car (minor).

$$(J) \times \text{STOVT} = (M) \qquad (M)$$

The total stopover time per car, multiplied by the daily work load (minor), equals the total stopover time for the minor area.

$$(M) \times DWL = (N) \qquad (N)$$

The average stopover time (major) is equal to the summation of the total stopover time of all the minor areas, divided by the summation for all the minor areas of the total number of stopovers (minor) for all cars in operation.

$$\frac{\Sigma (N)\ (\text{minor})}{\Sigma (K)\ (\text{minor})} = \text{STOVT (major)} \qquad (O)$$

i. Work Rate in a Major Area

The work rate in a major area is equal to the total number of cars loaded in the major area, plus the total number of cars unloaded in the major area, divided by the daily work load for the major area.

$$\text{WR (major)} = \frac{(A) + (B)}{(C)} \qquad (P)$$

j. Average Freight-Car Layover Time in a Major Area

The average layover time for a minor area, multiplied by the sum of the number of cars loaded and the number unloaded, is equal to the total amount of layover time spent by cars in the layover stations of the minor area.

$$\text{(LAOVT) (minor)} \times (\text{NCL} + \text{CUN}) = \text{Total (LAOVT) (minor)} \qquad (Q)$$

The average layover time for a major area is equal to the summation, for all minor areas, of the total layover time, divided by the summation for all minor areas of the number of cars loaded plus the number unloaded.

$$\text{(LAOVT) (major)} = \frac{\Sigma (Q) \text{ for all minor areas}}{\Sigma (\text{NCL} + \text{CUN}) \text{ for all minor areas}} \qquad (R)$$

By using the above methods of calculation, even when the original operational data of the subsidiary units are not available, cadres of major units can compute the technical conditions obtaining in the major area from the technical conditions found in each minor unit as computed by its own cadres from their original operational data. This method of calculation is particularly useful to the Northeast Office for deriving figures for the technical conditions in the whole Northeast, and to the Peiping Office of the ministry for doing the same for the whole North-South network. Then the findings for both networks can be combined to derive the figures for the whole country.

F. <u>Space, Time, and Operational Factors in Car Turnaround</u>

There are three factors in car turnaround: (1) space (turnaround distance for all cars in operation); (2) time (car turnaround time); and (3) operational conditions.

1. Space

By controlling unreasonably short or long hauling distances, as well as eliminating all crosshauling and stimulating export trade policies, railway men may influence the turnaround distance, but the shippers are the major factor in determining turnaround distance. Furthermore, the various methods of limitation or control come within the scope of the commercial phases of the traffic wherein the space factor in turnaround distance is determined by objective conditions.

Those concerned with car turnaround can influence the space factor by providing improved facilities for reducing shunting distances, such as by skillful placing of tracks and switches in station yards; by reducing the kilometrage of empty cars and the empty car percentage; and by effecting similar reductions with respect to loaded cars, thus reducing the turnaround distance for all cars. Such benefits can be derived from good technical performance, and this is the only way the space factor in car turnaround can be affected.

2. Time

Under the same conditions as to turnaround distance, better technical performance of railway workers, with the help of improved equipment, will reduce turnaround time. Also, the fewer the required number of cars in operation thus made possible, the lower will be the costs of transportation. When the turnaround distance of all cars is greater, the turnaround time is also greater, although not in the same proportion. If the proportionate increase in turnaround distance of all cars is greater than the proportionate increase in car turnaround time, that indicates progress in technical performance. Conversely, under the same conditions of turnaround time, an increase in turnaround distance of all cars indicates excellent technical performance. In practice, freight-car turnaround time can be calculated from actual data on turnaround distance; but, it is definitely impossible to calculate turnaround distance from a predetermined figure for turnaround time. This, in general, is the relationship between the three factors of space, time, and operational conditions in the matter of car turnaround.

Because the variations in the three factors are in large measure mutually independent, the relationship in amount between the car turnaround times of the minor areas and that of the major area of which they are a part, and the relationship of the actual figures with the planned target figures are complex, variable, and without any definite proportion.

For these reasons, when considering the matter of car turnaround, we should pay attention not only to turnaround time, but also to turnaround distance and operational conditions.

#35

- E N D -

Sanitized Copy Approved for Release 2011/07/14 : CIA-RDP80-00809A000700230144-5